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VOICE CLIP REDUCTION DURING PACKET HARD HANDOFF

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VOICE CLIP REDUCTION DURING PACKET HARD HANDOFF

BACKGROUND

[0001] The invention relates in general to wireless networks, and in particular to a method and system for improving hard handoff in packet/voice networks.

[0002] Wireless communication networks provide the ability for one or more wireless or mobile nodes (generically "mobile units") to communicate with other mobile units or other nodes connected to wireless and/or wired networks. There are generally two types of wireless communication networks: circuit-switched and packet-switched.

[0003] Circuit-switched wireless communication networks typically include one or more Mobile Switching Centers (MSCs) for connecting to other switching centers and other networks, including the landline Public Switched Telephone Network (PSTN). Typical call control protocols in a circuit-switched network include ISUP (ISDN User Part) and Feature Group D.

[0004] Packet-switched wireless communication networks typically include a plurality of call servers and Media Gateways (MGs). SIP (Session Initiation Protocol) and BICC (Bearer Independent Call Control) are examples of call control protocols used in a packet-switched network.

[0005] The current approach to introducing packet based (e.g. Internet Protocol) multimedia services for wireless communication networks such as Universal Mobile Telecommunications Service (UMTS), Global System for Mobile Communications (GSM) and Code Division Multiple Access (CDMA) is to define an IP Multimedia Subsystem (IMS). IMS includes a plurality of IP-connected network entities using packet-switched services. These network entities provide IP

Multimedia features and services using such vehicles as Session Initiation Protocol (SIP) for call control.

[0006] The IMS shares little in common with the traditional MSC supporting circuit-switched services. Also, the IMS introduces design difficulties that are new and or different from those in circuit-switched services. For example, when a mobile unit goes through hard handoff in a packet based network, there may be a noticeable loss in packet voice information before the handoff is completed ("voice clip"). It is desired to reduce these difficulties, such as voice clip during hard handoff, in the packet network and other networks similarly configured.

SUMMARY

[0007] An improved system and method is disclosed for reducing difficulties, such as voice clip during hard handoff, in a packet network and other networks similarly configured. In one embodiment, a method is provided for performing a hard handoff of a call for a mobile unit operating in a packet communications network. A first link is established between a first media gateway connected to an existing radio resource serving the call and a second media gateway connected to a target radio resource for serving the call after the hard handoff. Before the hard handoff is executed, call information from both the target radio resource and the existing radio resource are simultaneously transmitted to the mobile unit. After the hard handoff is executed, the call information is only transmitted from the target radio resource.

[0008] In another embodiment, a method is provided for performing a hard handoff in a packet voice network. The method begins by detecting a potential handoff situation of a mobile unit to a target radio resource connected to the packet voice network. A speech path to the target radio resource is established through a target media gateway associated with the target radio resource. The target media gateway is instructed to transmit speech to the mobile unit through the target radio resource before the hard handoff occurs. The hard handoff may then be executed.

[0009] In one embodiment, an improved media gateway is provided. The improved media gateway includes a control interface for receiving control information from a remote node and first, second, and third call ports for transmitting and receiving packet call information.

The media gateway also includes a processor for performing instructions in response to received control information and a memory for storing a plurality of instructions. The instructions include instructions, responsive to a potential hard handoff from a first radio resource to a second radio resource being identified, for splitting a speech path from the first call port to both the second call port and to the third call port, wherein the first call port connects to a first terminal unit, the second call port connects to a mobile unit through the first radio resource, and the third call port connects to the mobile unit through the second radio resource. The instructions also include instructions, responsive to a completion of a hard handoff from the first radio resource to the second radio resource, for modifying the speech path to drop the second call port.

[0010] The present invention can be implemented in many different types of networks, including but not limited to, UMTS, GSM and CDMA type packet networks.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] Figs. 1, 4 and 5 are examples of a network incorporating one embodiment of the present invention.

[0012] Fig. 2 is a block diagram of a media gateway used in the networks of Figs. 1, 4, and 5.

[0013] Fig. 3 is a flowchart illustrating in detail a process of one aspect of the present invention.

DETAILED DESCRIPTION

[0014] Various aspects of the following disclosure provide a unique method and system for improved packet voice transmission and reduced packet loss during handoff in a cellular wireless communication environment. It is understood, however, that the following disclosure provides many different embodiments, or examples, for implementing different features of the invention. Specific examples of components, signals, messages, protocols, and arrangements are described below to simplify the present disclosure. These are, of course, merely examples and are not intended to limit the invention from that described in the claims. Well-known elements are presented without detailed description in order not to obscure the present invention in unnecessary detail. For the most part, details unnecessary to obtain a complete understanding of the present

invention have been omitted inasmuch as such details are within the skills of persons of ordinary skill in the relevant art.

[0015] Referring to Fig. 1, a communication system 100 is a Third Generation (3G) wireless system. Communication system 100 can alternately be any digital cellular system that provides services such as packet voice or voice-over-IP (VoIP). 3G wireless systems include multiple air interface standards, including cdma2000, Universal Mobile Telecommunications System (UMTS), Wideband CDMA (W-CDMA), Global System for Mobile Communications (GSM), and UWC-136, a TDMA-based technology.

[0016] Fig. 1 depicts nodes and links that have been defined based on network functions that will be discussed in greater detail below. Actual implementations may contain multiple copies of these nodes within multiple networks, may merge any of these nodes into single hardware entities, or may distribute portions of the nodes among several hardware entities. The architecture of the present embodiments is designed to utilize emerging Internet standards and protocols. An example of this is the use of Session Initiation Protocol (SIP) for IMS signaling for establishing a call. Use of emerging internet-based protocols allows for the IMS to provide internet-like functionality and services to mobile units along with voice and data services.

[0017] Communication system 100 comprises a plurality of nodes, including a mobile unit 102, Radio Access Networks (RANs) 104, 106, a packet-switched domain 110, another domain such as a circuit-switched domain 112, a plurality of Media Gateways MG1, MG2, MG3, and a call server 120. Each node can be selectively connected to one or more of the other nodes either directly through a physical or wireless connection, or through a plurality of intermediate nodes. The nodes and the plurality of intermediate nodes may serve to modify the connection as required, such as converting information between different packet, circuit, and/or wireless protocols.

[0018] Mobile unit 102 can be any device or combination of devices that can be used to connect with a wireless network. For example, the mobile unit 102 can be comprised of terminal equipment and a 3G mobile unit that communicates with communication system 100 via an air interface.

[0019] RANs 104, 106 provide an interface between the mobile unit

102 and the packet-switched domain 110. For example, RANs 104, 106 may be an IMT-2000 radio interface for a CDMA access network. Other examples include a UMTS Terrestrial Radio Access Network (UTRAN) for a UMTS access network or a GSM/EDGE Radio Access Network (GERAN) for a GSM/EDGE access network. In the present embodiment, RANs 104, 106 are selectively coupled to the mobile unit 102 via a wireless link, such as a 3G air interface. In Fig. 1, the RAN 104 is coupled to the mobile unit 102 via a first wireless link 122.

[0020] Packet-switched domain 110 is a network that may support many different types of packet-based communications, including VoIP. In one example, the packet-switched domain 110 may include a plurality of CDMA nodes such as Packet Data Service Nodes (PDSNs), Mobile IP Foreign Agents (FAs), Mobile IP Home Agents (HAs), and Authentication, Authorization and Accounting (AAA) Servers. In another example, the packet-switched domain 110 may include a plurality of GSM nodes such as Serving GPRS Support Nodes (SGSNs) and Gateway Support Nodes (GGSNs). Additional or alternative nodes may be used to provide packet-switched service, as required by the type of packet-switched domain being used.

[0021] Circuit-switched domain 112 is a network that may support many different types of circuit-based communications, including voice. In one example, the circuit-switched domain 112 may include a plurality of mobile switching center (MSC) servers and a plurality of gateway servers. The circuit-switched domain 112 may include the Public Switched Telephone Network (PSTN).

[0022] Media gateways MG1, MG2, and MG3 may share some or all of the features, or may be adapted to handle different requirements from supported domains, RANs, and so-forth. Media gateway MG2 supports inter-working of media flows to and from the RAN 104 through a communications link 124. Likewise, media gateway MG3 supports inter-working of media flows to and from the RAN 106 through a communications link 126. Media gateway MG1 is illustrated as interfacing with the circuit-switched domain 112 through a link 128. In the present embodiment, the media gateway MG1 is a conventional gateway device and operates according to conventional operational modes. It is understood, however, that in other embodiments, the media gateway MG1 can be modified as suggested herein. Media flows for the media gateways MG1, MG2, and MG3 may use various transport and

codec options, as are well known in the art.

[0023] Referring to Fig. 2, the media gateways MG1, MG2 and MG3 may include a plurality of components. Since in the present examples, the handoff is occurring between media gateways MG2 and MG3, these will be considered in further detail. For example, each of the media gateways MG2 and MG3 may include one or more processors 130 connected to a plurality of memory devices 132. The processor(s) 130 can perform general processing operations as well as process the voice signals for "interconnecting" communication paths between two or more of the various ports. The memory devices 132 may include various combinations of hard drive, random access memory, read-only memory, and removable diskettes. The memory devices 132 can by used for receiving and storing instructions for performing various tasks, including those of the present embodiments. The media gateways MG2, MG3 may also include a control interface 134 for receiving control instructions from other nodes in the network. In the present embodiment, the control instructions are formatted according to H.248 protocol. It is understood that H.248 protocol is only one example of a method for sending and receiving control instructions. Other examples include H.323 protocol and SIP protocol. The media gateways MG2, MG3 may also include a plurality of ports 136. The ports are for connecting to various nodes in the network, including the other media gateways in the communications network 100 and the associated RAN(s). It is understood that for different embodiments, different and/or additional components can be used. For example, when one of the RANs 102, 104 is connected to a circuit-switched network, the corresponding node may include a switching fabric as is well known in the art.

[0024] Referring again to Fig. 1, the call server 120 controls media gateways MG2 and MG3 via a control interface 140, which in the present example uses H.248 protocol. In one embodiment, the call server is a DMS-MTX provided by Nortel Networks of Ontario, Canada. Other embodiments may readily use call servers from other manufactures as well. In the present embodiment, the call server 120 supervises and controls voice/data path connections to the domains 110, 112 and other mobility switches.

[0025] Referring to Fig. 3, an improved hard handoff routine 200 can be used in a communications network to support the hard handoff of the mobile unit from a first radio resource to a second radio

resource. Referring also to Fig. 1, for the sake of example, the communications network 100 shows a call in progress from a first terminal unit (not shown) connected to the media gateway MG1 through the circuit-switched domain 112. In the present example, it does not matter if the first terminal unit is a landline telephone, a wireless telephone, a computer, or some other network node. A typical packet link 142 (e.g., a two-way voice communication path) is established from a port 144 on the media gateway MG1 to a port 146 on the media gateway MG2. Also in the example, the two-way link 142 may be connected to one or more intermediate nodes in the packet-switched domain 110.

[0026] Execution of the routine 200 begins at step 210 where a potential hard handoff is detected. A handoff occurs when a mobile unit transfers links from one radio resource to another. A hard handoff is a handoff in which there is a gap in supplying content to the mobile unit, such as a "break-before-make" type scenario. It is understood that there are many intermediate steps to detecting a hard handoff from an existing radio resource to a target radio resource. In continuance of the example of Fig. 1, a potential hard handoff is likely to occur from the RAN 104 to the RAN 106.

[0027] At step 212, the media gateway associated with the target radio resource is identified. In the present example, the target RAN is RAN 106 of Fig. 1 and media gateway MG3 is identified as the gateway communicating with RAN 106.

[0028] At step 214, a link is established between the media gateway serving the existing radio resource and the media gateway serving the target radio resource. Referring to Fig. 4, in continuance of the present example, a temporary link 152 (e.g., a one-way voice communication path from media gateway MG2 to media gateway MG3) is established from a port 154 on the media gateway MG2 to a port 156 on the media gateway MG3. Also in the example, the one-way link 152 is directly connected between media gateways MG2 and MG3, while in other examples, the link 152 may be connected to one or more intermediate nodes in the packet-switched domain 110.

[0029] At step 216, communications are passed by both media gateways to their respective radio resources, and towards the mobile unit. In the present example of Fig. 4, media gateway MG2 sends and receives voice communications (based on VoIP) to the RAN 104, which

sends and receives the voice communications to and from the mobile unit 102 via the first wireless link 122. At the same time, media gateway MG3 sends the same voice communications to the RAN 106, which sends the voice communications to the mobile unit 102 via a second wireless link 160. In the present example, the RAN 106 is only providing one-way communications to the mobile unit 102, but it is contemplated that a two-way communication can also be established.

[0030] At step 220, a determination is made as to the progress of the hard handoff. If it is still in progress, execution returns to step 216 where both radio resources are transmitting communications. If the handoff has completed, execution proceeds to step 222 where a conventional link is established between the caller and the target media gateway (now referred to as the new media gateway). Referring to Fig. 5, in continuance of the present example, a typical packet link 162 (e.g., a two-way voice communication path) is established from the port 154 on the media gateway MG2 to the port 156 on the new media gateway MG3. In other embodiments, the conventional link 162 may be between the caller's media gateway MG1 and the new media gateway MG3. In still other embodiments, if the temporary link 152 is sufficient, it can continue to be used as the conventional link 162.

[0031] At step 224, communications are passed by the new media gateway to its respective radio resource, and towards the mobile unit. In the present example of Fig. 5, media gateway MG3 sends and receives voice communications (based on VoIP) to the RAN 106, which sends the voice communications to the mobile unit 102 via the wireless link 160.

[0032] If at step 220 it is determined that the handoff has been aborted, execution proceeds to step 226. In the present example, there are many reasons to abort a handoff, such as the mobile unit powers down or the mobile unit moves away from an area served by the RAN 106. At step 228, communications are passed by the prior media gateway to its respective radio resource, and towards the mobile unit. In this case, the scenario returns to as it was in Fig. 1 where media gateway MG2 sends and receives voice communications to the RAN 104, which sends the voice communications to the mobile unit 102 via the wireless link 122.

[0033] Although only a few exemplary embodiments of this invention have been described in detail above, those skilled in the art will readily appreciate that many modifications are possible in the

exemplary embodiments. For example, the media gateways MG2 and MG3 can be part of different packet-switched networks and the handoff there-between can be an inter-network hard handoff. Also, either of the media gateways MG2, MG3 can be connected to a circuit-switched domain and the present invention can reduce voice clip during handoff. Accordingly, all such modifications are intended to be included in the scope of this invention as defined in the following claims. In the claims, means-plus-function clauses are intended to cover the structures described herein as performing the recited function and not only structural equivalents, but also equivalent structures.